A new class of nanoporous nickel phosphates from treatment of miscible-miscible water-alcohol mixtures at high PT

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We used transitions from immiscible to miscible solvents under hydrothermal conditions to produce nanoporous nickel phosphate tubes (Fig. 1). We hypothesize these transitions provide means to separate reactants prior to self assembly at the conditions of PT where the miscibility gap closes.

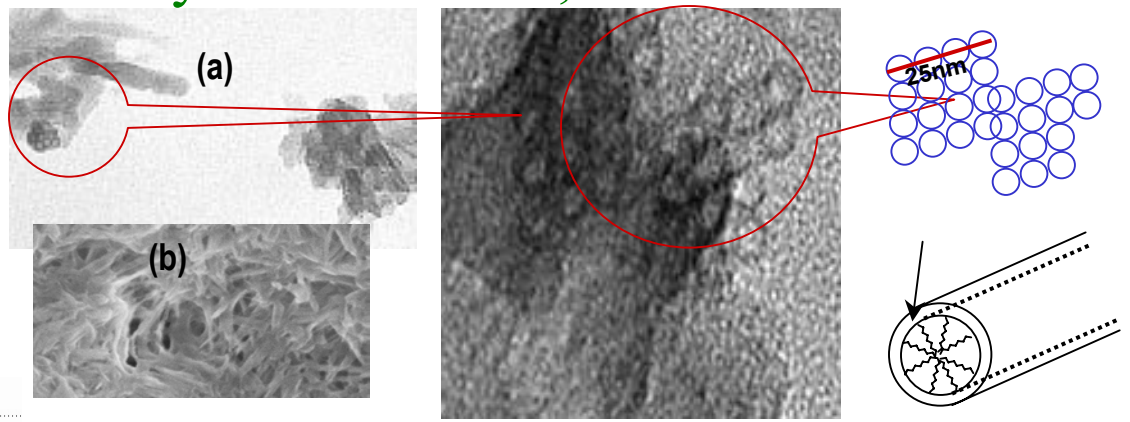

Fig. 1. (a) Transmission Electron and (b) scanning electron microscopic images of nickel phosphates prepared in BuOH/H_2O with diaminooctane. These images confirm the formation of tubular structures, with several tens of tubes packed together aligned parallel to the beam (circled) and laying flat on the TEM grid. The diameter of a tube is about 50nm, which is in good agreement with the position of the first peak in XRD pattern (Fig. 3).

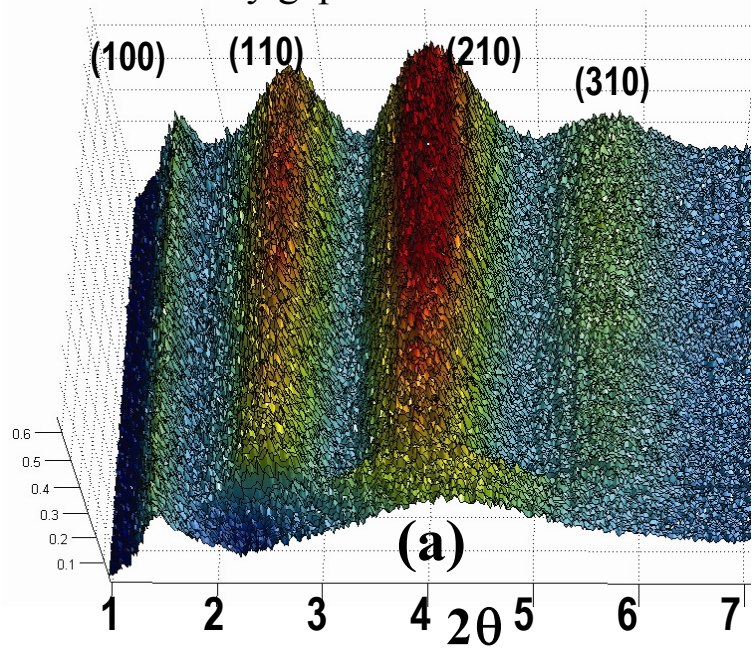

Fig. 2. Time resolved data (time into page) collected with CuKα radiation in 2 hr during the crystallization of NiPO-nanoporous phase (T=110°C) from BuOH/H_2O (3:1). Runs *without* butanol do not produce the nanoporous structure. The organization within the gel prior to reaction can be seen in the broad features at 2θ=1.5 and 4°. The pattern can be indexed on the basis of a 2-D hexagonal cell with a ~ 60Å.

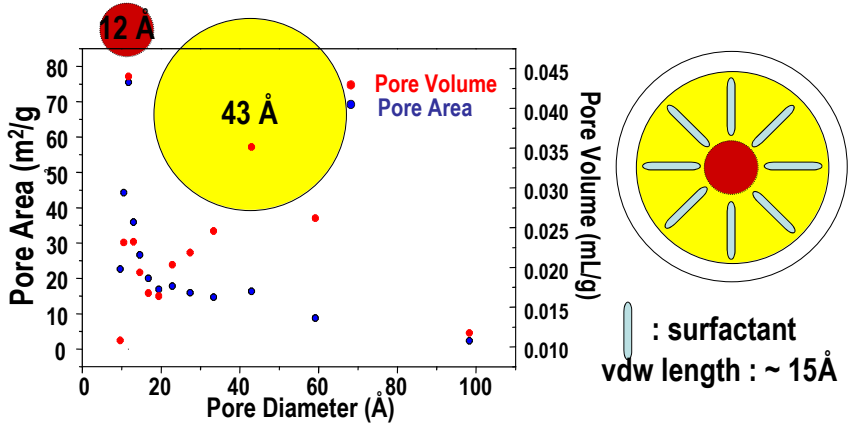

Fig. 3. Pore size distribution using the BJH model from the desorption branch of the isotherm. The sample was treated at 350°C overnight. TEM shows the tubes (Fig. 1) are essentially in tact. While not all channel contents are removed two distinct pore volumes correspond well to a model (right) with diaminooctane included in the channels.

nanoporous nickel phosphates from water-alcohol mixtures

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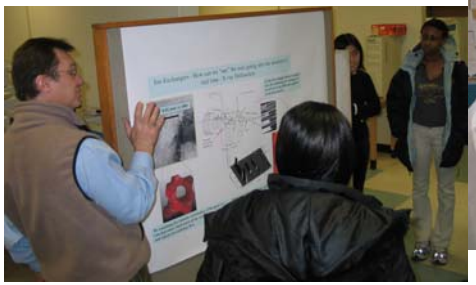
Education:

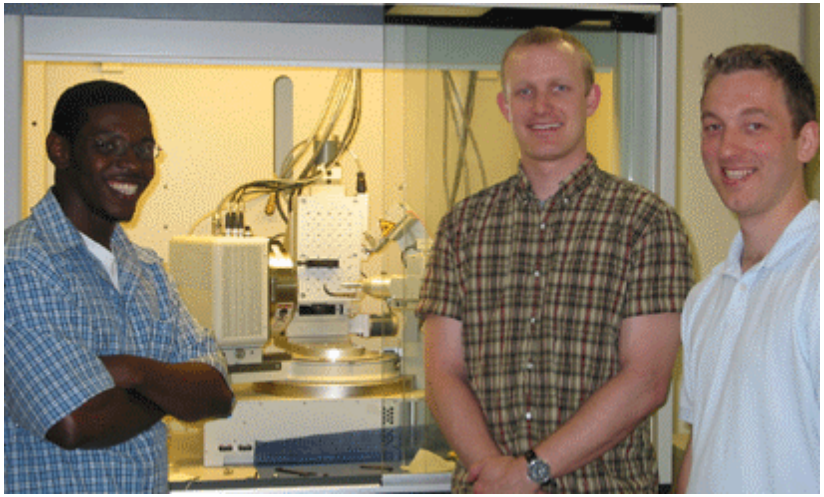
Undergraduates (David Moreau, Donique Jones and Skylar Pais) high school students (Danielle Jenkins, Cristian Maraver and Saroja Vivekanandan) and graduate students (Aaron Celestian, Dave Martin and Hyunsoo Park), and a postdocs (Ivor Bull) contributed to this work in 2003-04. We continued our work with groups of high school honors students from local high schools (particularly Sayville High) who tour our laboratory.

Outreach:



PI Parise and graduate student Hyunsoo Park (part obscured by poster board) explaining recent results derived from time-resolved powder diffraction to a group of Sayville HS honors students.

Sayville HS Junior Danielle Jenkins (left) and postdoc Ivor Bull prepare a demonstration of ion exchange for Danielle's classmates.



Stony Brook undergraduate Donique Jones (left) with graduate student Aaron Celestian (middle) and post doc Ivor Bull preparing a time resolved diffraction experiment on the GADDS instrument.

Undergraduate David Moreau of Stony Brook (left) and Skylar Pais of Alfred were part of the summer 2004 REU program in the Center for environmental Molecular Sciences and worked on aspects of synthetic solid state chemistry. David, shown demonstrating aspects of his research to a group of high school students, also worked in the laboratory during the semester in '03-'04 and will be involved in future work on the nano-phases described previously.